

*An Abstract of a Letter from the Learned Dr. Cole
Physician at Worcester, dated May the 13th.
1685, concerning Stones Voided per Penem.*

Sir,

IF the exclusion of two *Stones* (of the bigness *Fig.* 10. and 11) by the *penis*, without any, or any considerable pain, be worth notice, be pleased to know, I had the account of it from the person that Voided them. I saw the *Stones* and took the bigness, and circumference, (of which the strait line is the measure, they being in the thickest part much of a bigness) of them, by tracing lines about them as they lay upon a paper for the shape, and measuring them with a thread for the circumference. He told me he was for many years subject to great pain, first in the *Kidneys*, and afterwards in the *Bladder*, when that in the *Kidneys* ceased. But since their exclusion (which was about a year since) he was free from pain till the time I saw him, which was (as I remember) about half a year since.

JOHANNIS HEVELII, *Consulis Dantiscani*, Annus Climactericus. *Gedani* 1685. in Folio. *Wherein (amongst other things) he vindicates the justness of his Celestial Observations, against the exceptions by some made to the accuracy of them.*

THIS Learned, Accurate, and Diligent *Astronomer*, in his *Dedication* and *Preface*, (and elsewhere occasionally in the Book,) doth bewail the great Calamity he suffered by Fire, in the year 1679; wherein (*Sept.* 26)
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in a few hours, his Houses (seven in number) with all therein (his money, plate, gold, Silver, and all his household goods, his Printing-houses, with the furniture thereof, and great part of his Library; and the remaining copies of all his printed works set forth at his own charge from the year 1647 to 1679,) and particularly his dear *Urania*, and all its Observatories, with all his Instruments, *Astronomical* and *Optical*, (described in the former part of his *Machina Cælestis*,) and many other things of great worth, were in a manner wholly consumed, and turned to Ashes and himself well nigh deprived of all.

And doth withall complain of the unkindness of some whom he had taken for friends; who, instead of pitying his Calamity or assisting him therein, did rather insult over it (or tacitly please themselves therein,) and, by giving him new troubles, added to his affliction,

But acknowledgeth and gratulates Gods goodness; that (before this Calamity) he had (the same year) finished and published the latter part of his *Machina Cælestis*, containing the observations of almost fifty years; (which are thereby preserved :) That some of his Papers, (particularly his new *Catalogue* of the fixed Stars,) were strangely preserved from the fire: And, that (without being wholly despondent) God hath yet given him life and courage, to resume his former studies, to rebuild his Observatory, and furnish it with necessary Instruments (though much inferiour to those incomparable ones that perished by the fire;) and to apply himself to deduce a-new (from their first originals) much of what he had written (which was wholly destroyed) relating to his *Prodromus Astronomiæ*, his *Correction of the Tables*, his *Uranographia*, and his new *Celestial Globes*, which he hopes (through Gods assistance) in a short time to fit for the publik.

This piece (the first by him published after that dreadful Conflagration) he calls his *Annus Climactericus*, as

being the *Forty ninth* year of his observations, (49 being 7 times 7;) and because of that great revolution of affairs which in that year did befall him; the beginning whereof, and the greatest part of it, being much to his content, but the end of it so sad and dismal.

Amongst the happinesses of that year, he reckons, first, his finishing and publishing the latter part of his *Machina Caelestis* (containing the observations of 48 years.) And then, the coming of Mr. *Hally* to him at *Dantfick*, and abode with him for some months; and the great satisfaction he received therein. Having, before, much desired, that some from the *Royal Society* at *London* (acquainted with the way of observing there, by *Telescopick Sights*;) might come to him to *Dantfick*, to view the manner of His observing, (by plain sights, and the naked Ey:) Who having thus been an Ey-witness of both ways might satisfy that *Society* of the comparative goodness of both; at least, that His way of observing was not so despicable, as might by some be thought or be pretended. And the great satisfaction that Mr. *Hally* did (much beyond his expectation) there receive, the *Author* looks upon as a great happiness. And, that this happened before that dismal destruction of his Observatories and Instruments: (for, after that, it would have been impossible :) And, that the Observations then made (in Mr. *Hally's* presence, and with his assistance,) were wonderfully preserved from the fire, wherein so many of other things perished.

For there had (divers years before) happened a controversy between Mr. *Hook* and him (and divers letters passed thereupon) concerning the excellency of *Telescopick Sights*; which Mr. *Hook* did much prefer before the *Plain Sights*; used by *Tycho*, by the *Landgrave*, by all observers heretofore, and by this *Author*. As if it were not possible, with these *Sights*, (be the Instruments never so large or accurate,) to make Observations nearer
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then to Two or Three whole Minutes : But. himself could, with *Telescopic Sights*, (by an Instrument but of a span breadth,) make observations, Thirty, Forty, Fifty, yea Sixty times more accurate, than could be done the other way with the most Vast Instruments. And, upon the *Authors* publishing that first Part of his *Machina Cœlestis* (wherein all his Instruments are accurately described) Mr. *Hook* published his *Animadversions* thereon; with much more of bitterness and boasting (as this *Author* thinks, and others also whom the *Author* cites,) then there was reason for. Which he thinks was done out of design to disparage Him, his Instruments, and his Observations (unsight and unseen,) and to prepossess others with mean and slight thoughts of them, (even before they were yet published;) and a high opinion of himself who (with so little charge and so small Instruments) could do things so much more accurate than had hitherto ever been done, by any: thus seeking to raise his own reputation by disparaging what is done by others, in things wherein himself doth nothing.

The *Author* thinking the Credit of his Observations (and consequently the Benefit which the Publike might receive from them) to be herein much concerned; (for, if they were not to be trusted or relyed upon, with more accurateness than with the latitude of two or three minutes, they would fall much short of what the world expected from them :) he complained hereof in his Letters to divers learned men, and particularly to those of the *Royal Society*, desiring that right might be done him in this point. For that a difference of this nature, was not to be determined by conjectural speculations which a man may project to himself, (who brags only what great things he can do, but doth nothing :) But by Practick experience, and Trials actually made both ways; and these duly examined and compared by persons competent to judge of such matters.

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For there be advantages, and disadvantages, in both ways; which may, by sharp words, be aggravated to a great height; while yet, whether of the two, upon the whole matter, is to be preferred, cannot be otherwise determined than by experience.

And in order hereunto, the *Author* had again and again desired, with earnestness, that Mr. *Hook* would vouchsafe to give him (at least) these eight Distances, observed by his Instruments (great or small, as he pleased,) to be compared with the same observed by this *Author*. Namely, 1. *Lucidæ Arietis, à Polilicio*; 2. *Hujus à Polluce*; 3. *Pollucis à Regulo*; 4. *Reguli à Spica Virginis*; 5. *Hujusque à superiori in manu Serpentarii*. 6. *Hujus ab Aquila*; 7. *Hujusque à Marcab*; 8. *Atque hujus demum à Lucidæ Arietis*: But could never obtain from him either these or any other. Though it had been no hard request to grant it, if Mr. *Hook* could (as he tells us) perform according to his method) 100, yea 200 Observations in one night.

He had from *Bullialdus*, *Buratinus*, *Fullenius*, and others, who had been By-witnesses of his observations, and assistant at them, great attestations of their accurateness: Others who had not so been present, had yet a great esteem for them, notwithstanding the exceptions made to them by Mr. *Hook*; blaming his censure as undeserved and too severe: And others even of those who had a great opinion of *Telescopic Sights*, and did themselves make use of them, had yet a far other opinion of his Instruments and Observations, than what had been expressed by Mr. *Hook*; And thought at least this demand of his, very reasonable, That it might be free for either to make use of such Sights as themselves thought best, or were best acquainted with, without taking upon them to prescribe to others (over whom they had no Authority;) or to reproach and vilify them because not of the same opinion with themselves. All which matters of fact are made to appear by divers Letters there printed, which had

had passed between him and other learned men on that subject.

But he had further desired (for the greater satisfaction of all) that some one or other might come over to him, from the *Royal Society*, (well acquainted with the Method of observing by *Telescopick Sights*,) who might (upon his own view of the *Authors* Instruments and manner of observing, and by comparing those with his) satisfy himself; and report to the *Society*, for their satisfaction, what himself by experience should find true; and whether there were indeed such cause of complaint as what Mr. *Hook* had made.

Agreeably to this desire of his (which he recounts as a great happiness) Mr. *Edmund Hally*, a Member of the *Royal Society*, who had a very good opinion of *Telescopick Sights*, and was himself accustomed to use them, and had (a while before) made a Voyage to the *Isle* of *S^t. Helens*; and there (with such) made observations of the Fixed Stars in the Southern *Hemisphere*, (many of which are to us unseen,) whereof he had then lately published an account in Print; did, from the *Royal Society*, arrive at *Dantzick*, May 26. 1679. and there continued, with the *Author*, till July. 18. and was all that time a constant attendant at his observations; and had with him (of his own) a very good Instrument furnished with *Telescopick Sights*; the better to compare thereby the one and the other way of observation.

The same day that Mr. *Hally* arrived (May 26. 1679) he did, in Mr. *Hally's* presence (as a specimen of his manner of observing and the accurateness thereof) take (with his large brass *Sextant*) the Distance of *Regulus* and *Spica*; (Mr. *Hally* having so desired, as doubting whether he could, in his presence, determine to a minute, the same distance which he might have possibly, some time before, observed:) Which (notwithstanding the disadvantage of the light Summer-nights, and

the *Moon* then shining) he found to be 54° . $1'$. $55''$. the same exactly, even to seconds, which he had, before, six times observed in the years 1658. 1661. 1671. Whereat Mr. *Hally* being much surpris'd, (as not expecting that accuracy,) it was again for his greater satisfaction (that he might not think it only a great good-hap) observed the same exactly, *June*. 1. and again *June*. 7.

Many more observations were made from day to day, during all the time of his abode there, such particularly as Mr. *Hally* (for his satisfaction) did direct. To which he attended constantly, and did strictly examine them, with great diligence and curiosity; that he might not by any mistake be impos'd upon. Which observations are all, here, particularly sett down. And amongst the rest, (to compare the accurateness of the two sorts of *Sights*,) a list of divers observations made by the *Author* (with a small Instrument and common *Sights*,) and the same made by Mr. *Hally* (with a much larger and *Telescopick Sights*;) By which the *Author* thinks it will be evident to an indifferent Judge, that those performed by the Plain *Sights*, (though in a smaller Instrument,) are the more accurate. And doth seriously profess, that he could not with Mr. *Hally's* Instrument (though he did truly endeavour it) make observations with that accuracy and that readiness, as with his own.

Upon the whole matter, Mr. *Hally* finding all much to his satisfaction, and beyond his expectation, thought fit to leave in writing his Attestation thereof, (in form of a Letter to the *Author*, dated *July*, 8, 18, 1679.) wherein he declares himself *abundantly satisfied of the use and certainty of these his Instruments and Observations*, And whereas he had, before been always doubtful, that his observations by naked *Sights* might, as to some Minutes, be uncertain; and had therefore wondered why he declined the use of *Telescopick Sights*; (though yet

yet he was loth to call in question the truth of them, but preserved always a just veneration for them :) He had, (partly to gratulate the Authors publishing of his observations, and partly to satisfy his own scruples,) undertaken that journey; which he now looks upon as no small happiness; and declares himself abundantly pleased with it. And offers himself a voluntary witness, (of the almost-incredible certainty of those his Instruments,) against all who shall for the future call his observations in question. As having seen, with his own Eys, not one or two, but a multitude of observations of the fixed Stars, performed with his great Brass Sextant, (even by divers Observers, and by himself sometimes, though less expert therein,) being again and again repeated; most accurately, and almost incredibly to agree; and never to differ more than by an inconsiderable part of a Minute. With further expressions of Joy, and Admiration; as wondering at nothing more, than to find them so accurate.

The Author being by these Observations, confirmed in his resolution of adhering to *Bare Sight*s with his *Naked Ey* (without glasses;) and having satisfied Mr. *Hally* as to the *Certainty* and *Accurateness* thereof (far beyond what Mr. *Hally* could expect;) thought fit in the first place (after his *Machina Cœlestis*) to publish these (for the satisfaction of others) to preserve the just reputation of his observations before published, which Mr. *Hook* had endeavoured to render suspected.

He therefore gives us first, his observations of the year 1679. beginning from Jan. 8. *St. n.* (where his *Machina Cœlestis* ended;) and so onwards till May 26, when Mr. *Hally* arrived. And therein (amongst others) the *Transit* of some Stars, and the *Occultation* of some others, by the *Moon*: Mar. 25. Mar. 30.

From thence to Jun. 18. we have an account of all his observations made together with Mr. *Hally*, with the success thereof. And (amongst the rest) of the oc-

cultation of *Jupiter* by the *Moon*, (a case that seldom happens) *Jun. 5.*

And thence to *Sept. 26.* (the fatal day when his observatories with all their furniture were destroyed) which concludes the observations of that year.

After these observations, of the year 1679; are 27 Letters which had passed between the *Author* and divers other learned men, relating to the controversy between him and Mr. *Hook*, about the use of *Telescopic Sights*.

The First, Third, and Fifth, are from Mr. *Henry Oldenburg*, *Secretary* to the *Royal Society*; and contain (beside some other things, declaring the *Society's* great respect for the *Author*,) Mr. *Hook's* description of his *Telescopic Sights*, with his reasons urging the use of them, Affirming that, for any Celestial observations, *an Instrument, with these, though but of the Radius of one Span, may be made more exact, than, with common Sights, the best that can be made, though of three-score foot Radius. That, whereas the naked Ey can hardly distinguish an angle of a Minute, it may thus distinguish a single Second.*

The Second, Fourth, Sixth, and Seventh, are the *Authors* answers to those; maintaining the contrary. Not thinking it possible, that so small an Instrument can do such great things; and that, with his own, he can distinguish a much smaller angle than Mr. *Hook* will allow. Appealing to experience (which is to be the judge in this case:) and desiring (for instance) Mr. *Hook's* Observations, (by his Instrument) of Eight distances proposed; to be compared with his own Observations of the same; that it may be thence judged, whether are the more exact. (But could not obtain any one.) And he believes that those who thus commend these, if they had ever made trial of such large Instruments,

arguments, at least continually for some considerable number of years; and were with such small ones to attempt (not one or two single distances, but) the Restitution of the fixed Stars as himself hath done; they would be of another mind. But (leaving them to enjoy their own opinion) desires at least it may be free for him to use his own way, wherein he is confirmed by the experience of so many years; and from which he hath many reasons why not to depart.

The 8th. from M. *Ismael Bullialdus*; and the 9th. from *Bernhardus Fullenius*, (a Dr. of Law, and Consul of *Franecker*,) are gratulatory Letters upon the Edition of his *Organographia* and his Instruments therein described; highly commending them, and the great accuracy of the Observations made thereby (of which both of them had been Ey-witnesses, and esteem it a great happiness so to have been;) and with so great exactness (within less than 6 Seconds) as, without having seen it, they could hardly have believed. And, the latter of them (upon occasion of an Observation published by Mr. *Hook*, aiming to prove a Parallax of the Earths Annual Orb;) declares his suspicions of the uncertainty of *Telescopick Sights*, preferring others before them.

The 10th. is of the *Author* to D. *Fullenius*, complaining of Mr. *Hook*'s unhandsome usage of him in his *Animadversions* on the *Authors Organographia*, or first part of his *Machina Cœlestis*, (then newly come to his hands:) As making it his business, to carp at all his Instruments, and render them suspected; to blacken and disparage to the Learned World, all his Observations; (which yet he had never seen, nor could see.) As That his Instruments are not larger than *Tycho*'s; nor his Divisions better, nor his Observations more accurate. That 'tis not possible with those Instruments and the naked Ey, to discern an intire Minute, or determine to a Minute either Altitudes or Distances. And

doth in a manner, from step to step, carp and cavill at all and every thing. Boasting, that himself can perform all by a very small Instrument, with *Telescopick Sights*, Thirty, Forty, yea Threescore times more exactly: (while yet he hath not, that this *Author* knows of, ever published to the world any one considerable Observation performed by himself.) Concerning which this *Author* appeals to the judgement and experience of this his friend (who had often seen the practice of it) whether he could not clearly distinguish *five Seconds*; even without the use of Diagonal lines (as Mr. *Hook* pretends, and cavils at it.) And whether he can imagine that Mr. *Hook* can with an Instrument of one Span (so instructed as he describes) perform things Fifty, or Sixty times more exactly, than he with his of 6 or 8 foot Radius. And, what difference he thinks there may be between the parts distinguished by Diagonal slope-lines (cutting the Arches of Concentrick circles) and those of the same Arches by streight lines from the Center, (which this *Author* also there useth; leaving it indifferent to judge, either by the one or the other, as the observer pleaseth.) But wonders that Mr. *Hook*, who hath never yet performed, or so much as attempted, any thing in this kind; should take upon him thus to censure others. Thinking that it more becomes learned Men, not to boast of what they *can*, or *will*, or *mean* to do, but rather to let the world know what they *have* done. And when Mr. *Hook* hath performed things so much more accurate, it will then be time to tell the World what they are.

The 11th. is a letter of his, of like complaint, to Mr. *Oldenburgh*; Adding moreover, that Mr. *Hook* should rather have written his Animadversions in *Latine*, or gotten some body to put them into *Latine* for him, (as for those formerly concerning M. *Auzot*,) and not put those (that are not perfect masters of the
English

English tongue) to the trouble of getting them translated. That he is sorry to be putt upon a necessity of wrangling, and empty words, (not because he thinks it hard to answer what Mr. *Hook* objects, but because it is contrary to his inclination, and will take up time which might be better imployed,) this being a matter not to be decided by empty words and altercations, but by experience and practise. That himself useth, in his own studies, to mind rather his own business than that of others; without prescribing to others (Dictator-like) what steps they must follow, and impose on them his own methods and contrivances, as absolutely the best, safest, and subtlest, of all that may ever be invented by any man: whereas Mr. *Hook*, he finds, more inclined to meddle with others business than with his own; and rather to find fault with what is done by others, than to do any thing himself. That he makes it his business to perswade him and all the world, that his own way is the best, safest, and most exquisite, which ever can be invented by any; reproching this *Author* all along for not obeying him and following his dictates, (as if this *Author* were one under his command;) Bragging only of what he can do, but doth nothing. That he thinks it would better become Mr. *Hook*, to suspend his judgement a while till he have taken time to examine (or at least to see) what is done by others; before he talk at this rate of all that is, or hath been, or ever shall be done in the world: while, in the mean time, he requires of others to give credit to what he says of his own Observations; before they can be seen, and examined, or even made. That if this *Author* (who without stipend or publike salary, without being hired or maintained to that purpose at the charge of others, without any duty or obligation upon him thereunto, other than his own inclination to these studies, and his willingness to serve the publike, hath, at
his

his own charges, with the expence of so much time and labour, done what he was able, and with good intention, and so much more than Mr. *Hook* either hath done, or is ever like to do,) hath deserved to be thus slighted, scorned, and contemptuously exposed, almost in every page, (because he had not recounted Mr. *Hook* in the number of his cheif Fautors and Patrons;) yet the Noble *Tycho*, the Illustrious *Landtgrave*, or some others, (who are all equally concerned in his censures) might have been thought to deserve better; who will certainly be found, if not in all things (for the best are liable to mistake sometimes) at least in some things, to have performed better than Mr. *Hook* is willing to allow them. However, this he hath to say for himself, that neither Posterity, nor any of his Superiors, can say, that he was bound in duty to do more than he hath done. And, as to the unprofitable and useless charge, of which Mr. *Hook* so often speaks ironically and with contempt (as he doth also in his other seeming commendations,) it came not out of Mr. *Hook*'s treasury (that he need be concerned for it) and which will appear (the *Author* hopes) not to have been altogether in vain. That they who like not his Observations, may look by them, and wait for better, or make better themselves. That the purblind or short-sighted, may (if they please) make use of Spectacles and Perspectives; but himself, while his Ey-sight serves, shall chuse to make use of his bare Ey, and naked Sights. That it is free for Mr. *Hook* to make use of what Sights he pleaseth, (or none at all,) and to Observe (if he can) to the niceness of a single Second (of which yet the *Author* doth much doubt) and perform Sixty times more accurately than *Tycho*, the *Landtgrave*, this *Author*, or any other hitherto: but doth not own him, as his Prince or Dictator; nor will suffer himself, by his empty words to be perswaded out
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out of his own senses, and the experience of so many years. But he is satisfied in this; that, what Mr. *Hook* slights and undervalues, is by divers eminent, worthy, and learned men, well approved and commended; (who's praise he more values, as being from praiseworthy persons;) and doubts not but that they will be found more accurate than to one, two, or three intire Minutes (as Mr. *Hook* pretends, before he sees them) And hopes that, of the *Royal Society* (of whom he expresseth a great esteem) there are who will be ready to vindicate him from Detractors.

The 12th. is from Dr. *Wallis*, to the *Author*, the 19th. to him from *Titus Livius Burattini* (which latter had for some time been with the *Author*, and assistant at his Observations;) which (beside Gratulations, and just commendations of his Instruments, and his Observations) speak particularly of the Divisions in the limb by *Diagonals* (used by *Tycho*, the *Landtgrave*, this *Author*, and divers others;) to this purpose: That, the Division of an *Angle* into equal parts by streight *Diagonals* obliquely cutting concentrick Arches in the limb, would require, in Mathematical rigor, that the concentrick circles be set at somewhat unequal distances; and in smal Instruments, where the breadth of the divided limb is a considerable part of the Radius, (as $\frac{1}{2}$, or $\frac{1}{10}$ thereof) and the Angle to be so divided, of a considerable greatness (suppose, 10 minutes or more) it may require some little difference of intervals; (as the *Author* was well aware, and had himself given notice *Mach. Cœlest.* p. 139, 140,) But where the Instrument is large (as here, 6, 8, or 10 foot *Radius*,) and the breadth of the limb to be divided, but narrow (as here, about half an inch,) and (as here) the angle to be so divided but 5 minutes; the true intervals according to *Mathematical* rigor, are undistinguishable, to the subtlest sense, from equal distances. And, here, it is indifferent to

say, These intervals are such as by calculation they ought to be; or to say, The circles be equidistant: For no sense can distinguish the one from the other. And if there had been any difference; the *Author* had sufficiently provided for it, by performing the same divisions by straight lines from the center also.

The Computation (of Dr. Wallis) to which the Letter refers (the Method whereof is to be seen at large in the Philosophical Transactions Numb. 111.) is to this purpose. See the Figure 12.

Take we (for instance) his large brass Sextant (which is one of the Instruments which he did most frequently make use of,) where A, the Angle (at the Center) is 5 Minutes, to be divided into 5 equal parts, by a Straight Diagonal, obliquely cutting (in the Limb) 6 Concentrick Circles; (the length of the Ray, to each of which, we are to enquire.)

The Radius of that Instrument is (more than) 6 foot: and the breadth of the Limb (cutt by the Diagonal) is somewhat more than half an Inch; that is, somewhat more than $\frac{1}{11}$ part of the Radius.

We will allow it to be at least $\frac{1}{100}$ part of the Radius, (or even somewhat more than so:) and, accordingly, O, the Obtuse angle at the Base (contained by the Diagonal and the shortest Ray, or that of the In-most Circle) 172 degrees: And therefore V, the Acute angle at the Base, contained by the Diagonal and the Longest Ray, (or that of the Out-most Circle,) will (because of A, at the Center, of 5,) be $7^{\circ}, 55'$: And that at the Second Circle (next to it) will (because, here, $A = 4'$;) be $7^{\circ}, 56'$: And, at the third, $7^{\circ}, 57'$: And, at the fourth, $7^{\circ}, 58'$: And, at the fifth (which is next to the In-most) $7^{\circ}, 59'$.

Then (by that Case of Trigonometry where, The two Angles at the Base being Given, with a side Opposite to one of them; we are to Find that opposite to the other:)

other :) it is, As the Sines of the respective angles V, (in the several circles,) to that of the Angle O : so the shortest Ray (opposite to V,) to the respective Rays, in the several Circles.

That is; putting 1, or (1, 00000,) for the Ray of the In-most Circle; the rest are thus found;

Angles :	Sines	171, or, 80, 0'. Shortest Ray,		Differences.
7°, 59' :	1388850.	1391731 :: 1,00000	1,00000	
7, 58 :	1385970.		1,00207½ -	.00207½ -
7, 57 :	1383089.		1,00415½ +	.002 8 4
7, 56 :	1380208.		1,00625 -	.002 9½ -
7, 55 :	1377327.		1,00835 -	.002 10
		Longest Ray,	1,01046 -	.002 11

Where (the computation being made as accurately as the common Canon of Sines will permit) the Differences of Rays that is, the Intervals of the Circles; are so near to equals, as not to differ more than by an Hundred-Thousandth part of the (shorter) Radius. (The breadth of the limb, that is, the difference of the shortest and longest Ray, being somewhat more than the Hundredth part of the shorter Ray.)

That is (supposing the shorter Ray to be 6 foot, or 72 Inches,) the difference of Intervals between the concentrick Circles is not past $\frac{72}{100000}$ of an Inch. (Which is about one fourteen-hundredth part of an Inch.) Which no sense can distinguish from equidistants.

The 13th. from *Ismael Bullialdus* (who had himself also been a Ey-witness and Assistant at the *Authors* Observations, for some considerable time,) testifies his great resentment of Mr. *Hook's* dealings herein; as being astonished to see how far envy and a spirit of contradiction can transport a man. And thinks it a duty which the *Author* owes both to his own reputation, and to the publike, to vindicate himself and his observations from these aspersions. But thinks he cannot do it better

then by hastening the publication of them [*which since is done*] the sight of which will be so great a satisfaction to all equall judges, who understand (though but a little of) these affairs, that there will need no further apology.

The 14th. 15th. 16th. and 17th. are Letters which passed between Mr. *Flamsted* and the *Author*; discoursing the reasons why the one chooseth to make use of *Telescopick Sights*, and the other of *Plain Sights*: with some Observations imparted from each to other, and disquisitions thereupon. Mr. *Flamsted* excuseth some doubts he had, formerly, conceived about the uncertainty of this *Authors* Observations, even to One, Two, or Three Minutes. Which he acknowledgeth, upon sight of his *Organographia*, are in good measure satisfied. And the *Author* hopes he will be yet more satisfied, when he shall see the whole body of his Observations. Not that he pretends always to observe exactly even to seconds, or that he is not liable sometimes to commit an Error, (as all men sometimes are, because but men, whatever *Sights* they use; and of which there is instance in the few Observations that Mr. *Flamsted* imparts;) but that, when something of accident doth not interpose (and he mentions many which may a little disturb an Observation,) he can clearly distinguish five seconds, or even less than so; and when some Observations chance to be a little erroneous, they may be discovered and corrected by those that are more exact.

They both agree that *Tycho's* Catalogue of the Fixed Stars wants Rectification. The Errors of which, Mr. *Flamsted* thinks to have proceeded from *Tycho's* using *Plain Sights*; the *Author* ascribes them rather to his trusting to several Scholars of his, to make many of his Observations; some of whom were either not so skillful, or not so carefull, as some others were; either in making the Observations, or noting them down, or computing from them: On which account it is (he thinks)

thinks) that the *Haffian* Observations are in many things more accurate, (though they used the same kind of *Sights*,) than those of *Tycho*; because, there, the Observations were constantly made by *Rothman* and *Brig*, two diligent men.

The 20th. is of *Bullialdus* to the *Author*, returning thanks for imparting a copy of his letters to Mr. *Flamsted* (as at Ep. 13. for that of Ep. 11. to Mr. *Oldenburg*;) concurring with him therein; esteeming the use of glasses, less certain (because of the uncertain refractions) than *Plain Sights*.

The 21st. and 22^d. from Mr. *Oldenburg*, testifyeth, from the *Royal Society*, their continued esteem of the *Author*, and of his studies and labours, notwithstanding the artifices of some to the contrary; and that they were not privy to Mr. *Hook's* publishing his *Animadversions*. Giving a more fair character of Mr. *Flamsted*.

The 23^d. of the *Author* to Mr. *Oldenburg*, signifieth, that he is not displeased with Mr. *Flamsted*, (or others,) for using Glasses; which he allows in many cases (especially to those who are short-sighted) to be of good use; and commends in particular the Micrometer as an excellent Instrument for small distances. But desires that they will, without offense, permit him to use (what he finds best) *Plain Sights*. Which (where his Eyesight serves) he thinks much better: And, if he were now to begin that great work, of restoring the fixed Stars (about which he had been so long employed) he should take the same course as hitherto, by using *Plain Sights*. Wishing, that some of those who are so fond of *Telescopes*, were with him to discourse the matter, and see his Observations; and he beleeves they would then be of another mind.

The 25th. from the *Author* to Dr. *Grew* (then Secretary to the *Royal Society*, after the death of Mr. *Oldenburg*,) and the 26th. to *Dethlevis Cluver*; signify the arrival

rival of Mr. *Hally*, with which he was very well pleased; having long desired, that he might have opportunity of conversing with some, well acquainted with *Telejcopick Sights*, that so he might, not by words only, but by experience and practise, evidence to them the convenience and certainty of his Observations by *Plain Sights*. That Mr. *Hally* had now (for about a months time) diligently observed together with him, every fair night; That he was already well satisfied upon his own experience (and would, he hoped, signify so much to the *Royal Society*) that he found, upon tryal, things far otherwise than had been suggested by some (as if he could not, with his Instruments and naked *Sights*, distinguish to one, two, or three Minutes.) But intimates, that himself was not so well satisfied with Mr. *Hally's* Instrument with *Telejcopicks*; (having found, upon tryal, the suspicious true which before he had of them :) And is very well pleased, that he had not been prevailed with, to exchange his *Plain Sights* for such. And with it, he transmits to the *Royal Society*, his late Observation of the occultation of *Jupiter* by the Moon.

The 27th. (which is the last,) is from Mr. *Hally* to the *Author*; testifying his great satisfaction with the *Authors* entertainment; With the opportunity of conversing & observing with him; With his Instruments and accurate Observations, far beyond what he could have imagined; And offers himself ready to testify (against any who should hereafter question it) the great accuracy thereof (wondring at nothing more, than to find them so accurate,) and of their great agreement one with another; not varying more than by an inconsiderable part of a minute.

Now the distinguishing of 5", (which is actually distinguished in these Instruments,) is so nice a matter as answereth, upon Earth, to the twelfth part of an English mile
(allowing

(allowing 60 miles to a Degree of Latitude;) or the third part of a quarter of a Mile. Which is so nice, as that, whereas we are wont to enquire, what is the Poles Altitude at London? what at Paris? what at Dantick? and so forth: This is much the same as to enquire, what it is at Charing-Cross? and, what at White-hall Gate? (Supposing them to be distant Northward, one from the other, $\frac{1}{2}$ of an English Mile, or 440 foot,) or (because Degrees of Longitude; are, in the lesser Parallels, less than degrees of Latitude) much the same as to enquire, what a-clock it is at the East-end? and, what at the West-end, of the Abby-Church in Westminster?

The 18th. and 24th. from the Author to Mr. Oldenburg, are of another subject. Being a Continuation of the History, of the *New Star*, in the Neck of *Cetus*; which hath been observed sometimes to appear, sometimes to disappear, and then return again, and with very different degrees of light; as likewise of two such others in *Cygnus*, (one in the Breast, the other under the Head.) He had formerly (with his *Mercurius in Sole*, published in the year 1662) given an account of it from the year 1638 till that time. Which here he continues from thence to the beginning of the year 1677; and then again to the end of that year. And then again (after all these Letters,) from the beginning of 1678 to the destruction of his Observatory in 1679; and (after some intermission for that reason) from 1681, till toward the end of 1683.

Having dispatched what properly concerns his *Annus Climactericus*, and the Letters relating thereunto: He gives us the Continuation of his Observations since that time.

He begins with that of the *Comet*, (but without an Instrument, having lost all,) Dec. 2. 3. 4. (new stile) 1680. while it was Matutine (before the Sun-rising:) and

and then (according to his expectation) when it began to be Vespertine, *Dec. 24.* and so onward. Bewailing himself that he could not, as heretofore, with large Instruments, and long *Telescopes*, observe this so remarkable a *Comet*.

Jan. 1. 1681. (New Stile ;) he observed the occultation of *Palilicium* by the *Moon*.

And *Jan. 2.* and so forward, (having now gotten a small Instrument) proceeded (as he could therewith) in the Observation of the *Comet* with his Remarks upon it.

In *August* following he had re-built his Observatory, and gotten some Instruments, (but much inferiour to what he had lost.) Where his first Observation was an *Eclipse* of the *Moon*, *Aug. 29. 1681. ft. n.* And, after that, another very great one, *Febr. 21, 22.*

Then the Observations of another *Comet 1682.* With many others, of the Fixed Stars and Planets. And amongst the rest, the great Conjunctions of *Saturn*, *Jupiter*, and *Mars*; And a Transit of *Jupiter* by the *Moon*, observed (in the day time) by a *Telescope*, *Nov. 21. 1682. ft. n.* with many other *Transits* and occultations.

After which is a succinct account or History of the three great Conjunctions of *Saturn*, *Jupiter*, and *Mars*, in the years 1682, 1683.

Then the Observations of a Third *Comet 1683*, with the History of it. With several *Transits* and Occultations.

He tells us of a Fourth *Comet* observed by *Blanchinus*, at *Rome*, in *June. 1684.* (but not, that he hears of, by any body else,) at a time when himself (by indisposition of body) was not in a capacity of making Observations.

But he wonders how those of *Lipsich*, should not see this *Comet*, who pretend (about the same time) to have been the first discoverers of the *Nine* small Stars, under
the

the feet of *Bootes* (which they have formed into a new Constellation called *Gladii Lipsienfes*) just about the place where this *Comet* passed. Which Stars are no other than some by himself long since observed, and to be found (by other names) in his New Catalogue of Fixed Stars; and the Observations of them, published (amongst others) in his *Machina Cœlestis*. (Which, he doubts, could not by them, at that time, be all seen.)

On which occasion he takes notice also of *Two Schemes* of those in the *Moon*, published as his own by *Pere Cherubin*, (*Observations faites par le Pere Cherubin d'Orleans Capucin*) which are but copyed out of the *Authors Selenographia* pag. 222. 262.

He concludes with an Observation of the *Suns Eclipse*, *July. n. St. 12. 1684.*

A Course of Chymistry: by Nicholas Lemery; M. D. Translated from the Fifth Edition in French, by Walter Harris, M. D. Fellow of the College of Physicians. London 1686.

THE *Chymistry* of Monsieur *Lemery* is of such reputation in the World, that Notice of additions to it cant be thought ungratefull to the Reader.

This Edition is not only adorn'd with several Tables of Figures, representing the *Supellex Chymica*; but is also enlarged by the access of divers operations; as particularly the Pulverisation of *Tinn*, by casting it,

G g when

when melted in a Crucible, into a round wooden box, which has been whitend with Chalk on all sides within; then covering the box, and presently shaking it about, until the *Tinn* is become cold, and converted into a gray powder; in which form it easily mixes with Salts, and other matters. It also teaches the making Flowers of *Jupiter*; (which are *Tinn* Volatilized, and raised in form of Meal, by means of a Volatile Salt of *Salt-Peter*;) and the making an Oyl of *Mercury*, by dissolving sublimate Corrosive in Spirit of Wine; which may be done, altho' that Spirit is not able to dissolve Quick-Silver, nor *Mercurius Dulcis*.

A Caustic Oyl of *Antimony* is taught to be made by dissolving *Antimony* in the *Acid* Spirits of *Salt* and *Vitriol*.

A Method is given for drawing an Oyl and Spirit of *Paper*.

An Account of the *Peruvian Bark* is inserted, together with the manner of drawing a *Tincture*, and making an Extract, of it.

An Account is given of *Sugar*, and the Spirit of it, and of the *Phosphorus*,

Collegii Experimentalis, sive Curiosæ, pars Secunda;
per Jo. Christ Sturmium. Altorfi, 4°. 1685.

THE *Author* gives an account of the good success he had in using a *Glass Diving Bell*, made in a like form with that of *Wood*, mention'd by Monsieur *Panthot* in the *Journal des Scavans*.

He treats of some amendments in the *Air-Pump*; particularly of that kind which is portable.

He relates some experiments tried on the *Baroscope*,
Polish't;

Polish't planes &c. Some *Hygrostatical* Experiments, together with the description of the Instruments by which they were performed.

He writes of long *Siphons*, and their use in conveying Water; of *Glass Bubbles*, and the reason of their flying all into little peices upon breaking; of *Water-Pots*, sort of *Lamps*; and of *Stentoreophonic* Tubes; the invention of which he justly ascribes to Sr. *Samuel Morland*, looking on that Instrument of which *Kircher* makes mention, to be of a different shape from these.

He speaks of a new sort of *Thermoscope*, of the *Magdeburg Hemispheres*, mentioned by *Guerick*, and the difficulty of separating one from the other, when the Air included in them is rarified.

He discourses of the force of breath blown into a Bladder, and raising a considerable weight annex: and of the explaining muscular motion from this principle, after Dr. *Croon's* manner, proposing that by these means a statue of a man may be made to move in imitation of Nature.

He examines the experiment of the *Hydria Helmontiana*, urged by Dr. *More* as an argument for his *Hylarchic* Principle.

He describes an *Aerometer*, consisting of an *Hygrometer*, *Thermometer*, and *Barometer*. Speaking of magnetical Experiments, he affirms, that he has a large Needle, exceeding a *Rhinland* foot, and seven inches, both ends of which apply to either Pole of the *Magnet*.

To this Treatise the *Author* subjoyns an Epistle to Dr. *More* of *Cambridg*, concerning his *Hylarchic* Principle; where he examines the D^s Demonstrations of that Principle; and answers the arguments against the Elasticity of the Air,

Ophthalmographia, five Oculi ejusque partium descriptio Anatomica: cui accessit Nova Visionis Theoria, Regiæ Societati Londin. proposita. per Gui. Briggs, M. D. Colleg. Med. Londin. Socium, & Nosocomii Regal. (quod D^{vo}. Thomæ dicatur) Medicum Ordinarium. Editio altera: 8^{vo}. 1685. prostant venales apud Sam. Smith, ad Insignia Principis in Cæmeterio D Pauli; Londin.

Officina Chymica Londinensis; five exacta notitia Medicamentorum Spagyricorum, quæ apud Aulam Societatis Pharmaceuticæ Londin. præparantur, & Venalia prostant. Consilio Pharmacopæorum, & Approbatione Collegii Medicorum Londinensium exhibitum. Opera & studio Nicolai Staphorst, oper. Chym. dict. Societatis. prostant venales apud Gui. Miller, ad Insigne Glandis Auræ in Cæmeterio D. Pauli, 1685. 12^o.

Errata in the Transactions for *August*.

P Ag. 1107, lines 10, 11, 12, 13. Dele [viz. *Convulsions quædam observatis periodum, & Convulsivi affectus ultimam periodum à multis annis observatis.*] [Pag. 1113, line 4. for [*Convulsions--Observatis*] read [*Convulsiones - Observantes.*]

Errata.

IN the Transactions for *September* and *October*, in the pag. following 1169 for [1870] read [1170.]

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FINIS.

Fig. 1



Fig. 9

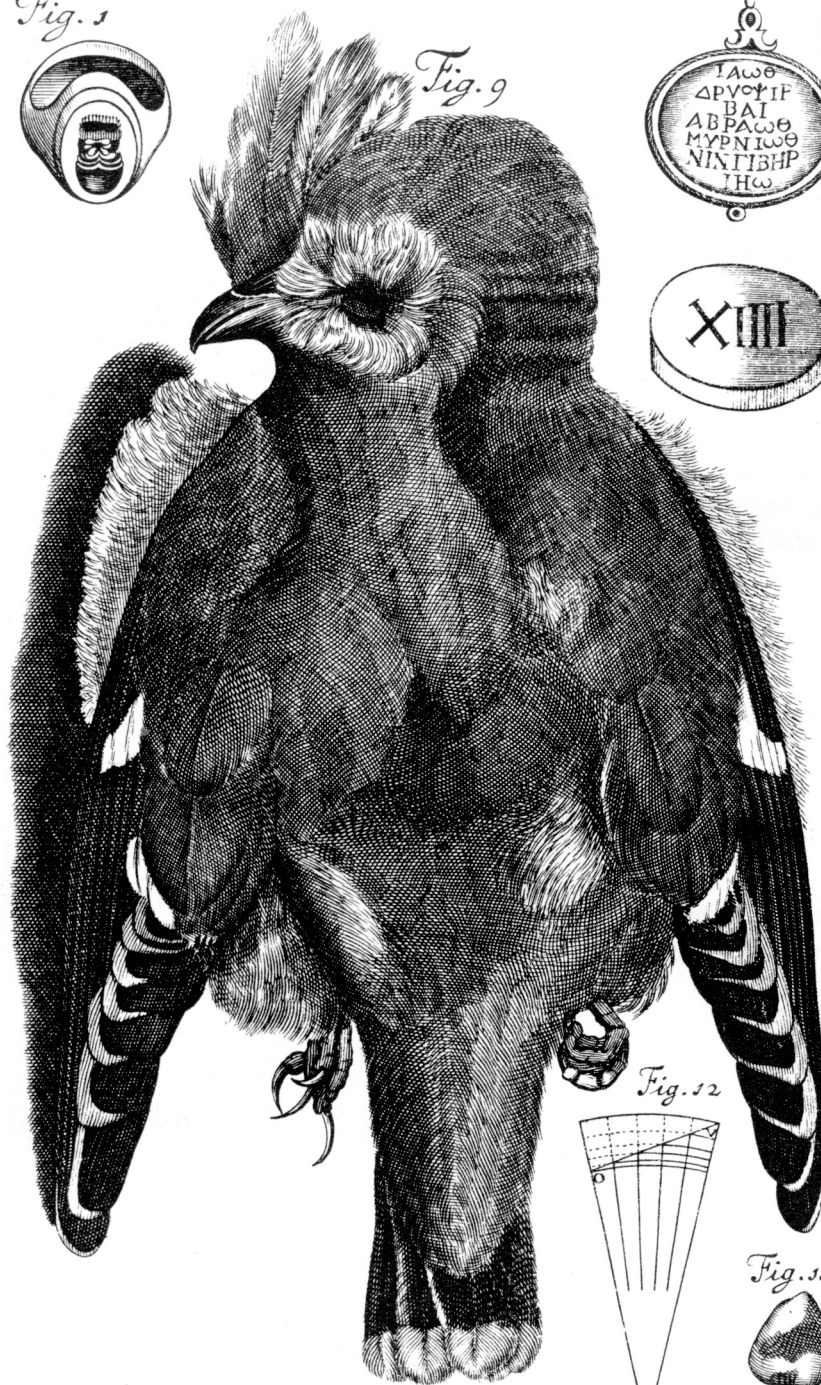


Fig. 2



Fig. 3

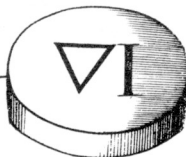
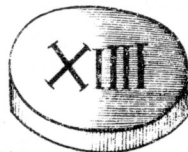


Fig. 4



Fig. 7



Fig. 5



Fig. 8

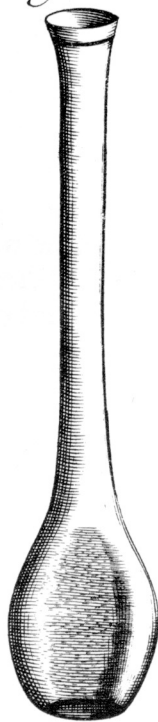


Fig. 6



Fig. 10



Fig. 11



Fig. 12

